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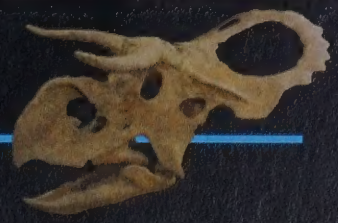


Principles and Practices
of Integrating Science into Land Management

CASE STUDIES

The case studies in this series showcase examples of integrating science into Bureau of Land Management (BLM) decisions and activities. They highlight how science has helped the bureau successfully manage diverse programs across many geographical areas. These examples are not intended as programmatic guidance or policy direction; the application of science will be unique to each circumstance. Rather, they reflect the critical thinking and systematic, transparent process advocated by the BLM's "Principles and Practices of Integrating Science into Land Management: Guidelines." By using that document's recommended Checklist of actions, they demonstrate key principles and practices of effective science integration at work in a variety of fields and resource areas. Individual case studies differ in how they satisfy Checklist objectives, illustrating that the Checklist is intended to be a flexible tool—one that can be customized to meet the unique aspects and needs of different projects. Comprehensive details about individual studies (including related articles and publications) can be found on the BLM's Science in Practice Portal, through the BLM Library and the Alaska Resources Library & Information Services, and through links in these documents.

CHECKLIST

☐ **1. DEFINE THE MANAGEMENT QUESTION(S),** including related management objectives. All interested parties must clearly understand the management issue(s) if the five guiding principles and practices are to be successfully applied.

☐ **2. FIND** available science relevant to the management question(s). Be systematic, rigorous, and objective, and use a method that is easy for others to follow and that is well-documented.

☐ **3. EVALUATE** the potential relevance and reliability of the science identified in Step 2.

☐ **4. SUMMARIZE** the science, address any conflicting science, and identify any information gaps.

☐ **5. APPLY** your science-based conclusions to the management question(s) to decide the best course of action for achieving management objectives.

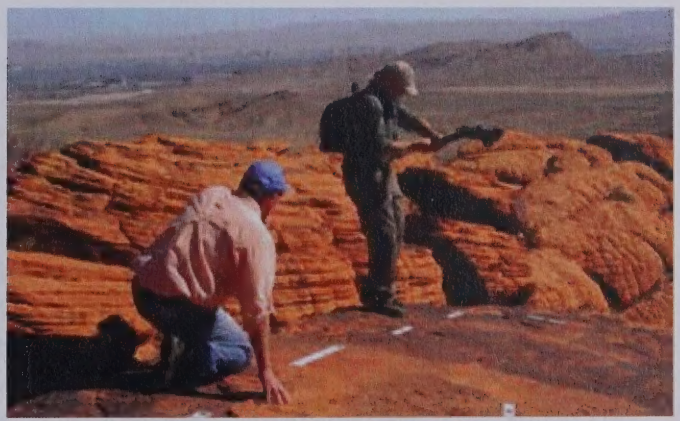
☐ **6. ASSESS** how the application of science affected public support, the sustainability and effectiveness of the decision, confidence in the course of action selected, and further learning about the system and the effects of management actions. Plan any future assessments and/or develop and implement a monitoring plan.

Snapshot of Checklist actions from "Principles and Practices of Integrating Science into Land Management: Guidelines." The numbered actions in the case study below track with this list and show how the BLM implemented the principles and practices for integrating science into the BLM's work. Please refer to the full document for details.

CASE STUDY 2: Potential Fossil Yield Classification System

1. DEFINE THE MANAGEMENT QUESTION(S).

Paleontological resources are an important part of America's heritage, garner much positive press for the BLM, and are an important source of scientific information concerning the history of life on Earth and changes in climate over time. The BLM is required to preserve paleontological resources using scientific principles and expertise (Paleontological Resources Preservation Act, 16 U.S.C. 470aaa) while accommodating multiple and diverse resource uses under the Federal Land Policy and Management Act. Data about paleontological resources on public lands have been systematically collected for more than 150



BLM paleontologists survey a dinosaur trackway at Red Rock Canyon National Conservation Area, Las Vegas, Nevada.

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years, providing a strong body of information for understanding how proposed land use actions may affect these resources. Most public lands, however, have not been surveyed for paleontological resources. Consequently, in attempting to protect paleontological resources on public lands, a key question for BLM managers has been:

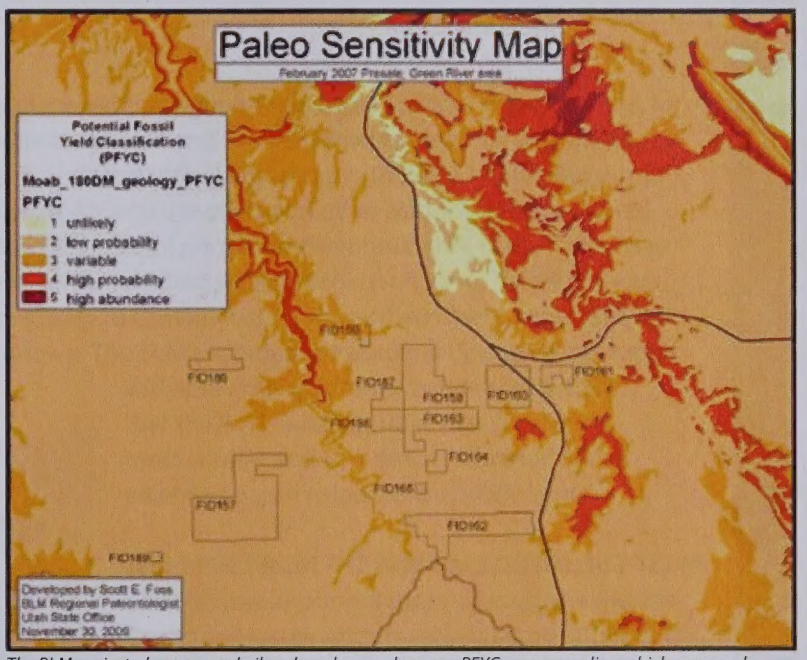
- *How can the BLM predict where important paleontological resources may occur on public lands?*

2. FIND.

There are more than 100 years' worth of published and unpublished literature, notes, and reports, including peer-reviewed scientific articles, about paleontological resources on public lands. In addition, the BLM has permit reports and records of internal surveys conducted in association with permits that have been issued authorizing the collection of paleontological resources. State geological surveys in most of the western states have also now developed high-resolution (normally 100K or better) digital maps of geological units (i.e., formations). Together these paleontological data and digital geological maps provide the foundation needed to better predict where paleontological resources may occur on lands that have not been adequately surveyed.

3. EVALUATE.

Paleontological resources occur as a result of complex geological, chemical, and physical conditions that are unique to each ancient soil or matrix in which they were formed. Many geological formations are not conducive to the formation of fossils, whereas others contain well-preserved flora and fauna from ancient times. The actual location of fossils is mostly unknown to the BLM because detailed surveys are out of date or inventory has not been performed. To predict where paleontological resources may occur on public lands, BLM paleontologists correlated data on the location, abundance, preservation quality, and overall significance of known paleontological resources with detailed digital maps of the geological formations where these resources occur. The product was a working model of areas where similar geological conditions exist and, therefore, where other significant paleontological resources may also occur. The resulting maps and accompanying reports comprise the Potential Fossil Yield Classification (PFYC) system. As stated in the BLM's national guidance on the subject (Instruction Memorandum No. 2016-124), the PFYC system may be used "to assess possible resource impacts and mitigation needs for federal actions that involve surface disturbance, land use planning, or land tenure adjustment."



The BLM projected a proposed oil and gas lease sale over a PFYC map, revealing which proposed parcels which would likely affect paleontological resources. Doing so allowed the BLM to attach the appropriate lease notices to this sale.

4. SUMMARIZE.

The PFYC system allows BLM staff to predict where paleontological resources may, or may not, occur. It does not replace surveys. Rather, the system allows the BLM to allocate resources strategically for new surveys of paleontological resources in areas where fossils are most likely to occur (as it is not practical or feasible to survey all surface and subsurface lands for paleontological resources). The PFYC system is continually updated to incorporate new information received from BLM paleontological permittees, museum partners, and field professionals. For

example, if fossils are found where they were not predicted, future models may elevate the presumed potential of that geologic unit. Conversely, if professional surveys fail to locate paleontological resources, the presumed potential of certain geological units may be lowered.

5. APPLY.

The PFYC system is intended to be used by BLM managers at the beginning of the planning process to predict where paleontological resources may occur. The PFYC system may inform not only where proposed land use actions may negatively impact paleontological resources but also where surveys are likely to be most helpful in determining the presence (or absence) of paleontological resources. The BLM encourages planners to use the PFYC system as a tool when determining proposed land use allocations, planning for resource extraction or land disturbance for specific projects, or (as an adjunct) in adjusting land tenure. Although the BLM employs a small paleontology staff to assist with specific assessments, most land use decisions are proposed and subsequently approved without input from a paleontologist. Because the PFYC system was developed using sound scientific methods applied to existing paleontological data, a manager may use it to make an informed decision, even in the absence of a professional paleontologist.

6. ASSESS.

In its practical application, the PFYC system helps land managers to determine where to focus resources (e.g., for on-the-ground surveys) before ground-disturbing activities begin and to assess the potential for paleontological resources to occur on parcels that are being considered for land tenure adjustment. The BLM has implemented the PFYC system now in many states and has incorporated it into use plans and other National Environmental Policy Act documents, where relevant. In addition, field offices and permitted paleontological consultants have consulted the PFYC system in deciding where to conduct further field surveys and monitoring. The PFYC system can also be used by researchers to identify formations likely to contain fossils—or, perhaps more important, to identify formations whose fossil potential is poorly known. The BLM encourages transparency and collaboration with and among external paleontologists, so that the BLM and the public may receive the most current and accurate information about paleontological resources on public lands.

The BLM paleontology team at Mill Canyon Dinosaur Trackways, Moab, Utah.

MESSAGE FROM THE BLM PALEONTOLOGY TEAM:

Scientifically important paleontological resources have been systematically recovered on public lands since the mid-1800s, long before the establishment of the BLM. Scientific and paleontological research on these lands have not only resulted in the discovery of new organisms but also revealed important information about the evolutionary history of ecosystem diversity and the Earth's changing climate.

The BLM manages more land and issues more paleontology research permits than any other land management agency. In addition, fossils from BLM-administered lands are displayed in more museums and make up a greater percentage of overall museum collections than those of any other land owner—often more than those of all other land owners combined. If you view a fossil in a museum anywhere in the United States, and often abroad, there is a good chance that it came from lands administered by the Bureau of Land Management.

Mill Canyon Dinosaur Trackways, Moab, Utah.

For more information, contact: **Scott Foss (Senior Paleontologist)** or **Greg Liggett (State Paleontologist)**.

Photos by BLM staff unless otherwise noted.

This case study series is sponsored by the BLM's National Science Committee to support science-based decisionmaking throughout the agency.

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